Report on the Tin and other mineral production of the Tenasserim Provinces and remarks on the Reports &c

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REPORT

109961

ON THE

TIN AND OTHER MINERAL PRODUCTIONS

OF

THE TENASSERIM PROVINCES.

BY

CAPT. G. B. TREMENHEERE,
EXECUTIVE ENGINEER, TENASSERIM DIVISION.

AND

REMARKS ON THE REPORT, &c.

BY

T. OLDHAM, ESQ.
SUPERINTENDENT OF THE GEOLOGICAL SURVEY OF INDIA.

Calcutta:
F. CARBERY, MILITARY ORPHAN PRESS.
1859

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REPORT

ON THE

TIN OF THE PROVINCE OF MERGUI.

BY

CAPTAIN G. B. TREMENHEERE,

EXECUTIVE ENGINEER, TENASSERIM DIVISION.

THE Tin of this Province has not been sought for, since the Burmese took possession of the country from their Siamese neighbours; under the rule of the latter, or during the period at which Tenasserim was an Independent State, extensive works for Tin were carried on. It occurs chiefly in the beds and banks of streams issuing from the primitive mountains which form the principal feature of this Peninsula: portions of the banks of streams in which it is found are, in some instances, rivetted with rough stone-work to confine the water for washing operations, and the ground on either side, for many miles along their course, is penetrated by innumerable pits, from 8 to 10 and 12 feet deep. Traces of the work of many thousands of men are evident in several places. These pits are not connected with one another, but seem to have been sunk by separate small parties of men, to whom probably definite tasks were assigned, with a view of tracing the Tin ground, and of extracting the gravel with which the Tin is mixed.

Their variable depth, and the amount of labor expended on them, is a tolerable indication of the success with which this has been pursued, and of the places in which ground might be again perhaps opened with advantage.

2nd. The streams themselves are rich in Tin, which may be collected from their beds in considerable quantities. The process by which it has been deposited for long periods, and for many miles along the line of valleys through which they flow, appears to be in active operation at the present day. Crystals of the peroxide of Tin washed down by the rivers and deposited with sand gravel in their beds, may, by changes of the river's course during the freshes, be quickly covered with a few

feet of gravel and soil. The older deposits have, as far as my observation extends at present, the same alluvial character, and it would be well in future operations to have regard to the levels in which the streams may have formerly run. The first of these localities which attracted my attention was the Theugdan river, issuing from the primitive mountains in the immediate neighbourhood of the coal mine on the Great Tenasserim river. I visited this river in the course of my survey of the Coal Basin, and found pits in great number along its banks, of the existence of which I had been previously informed, though the object for which they had been dug, was not known to my informant. On washing some of the gravel from the bottom of one of the pits, a small quantity of Tin was found.

3rd. A Shan was subsequently sent there and collected 11,889 grains of Tin, of the Native peroxide, in the course of an hour and a half, specimen No. 1, which is equivalent to 19 ounces and 198 grains of pure Tin.

4th. After leaving the vicinity of the Coal mine, I proceeded down the river, and was accompanied by the Shan, who had been employed in Tin works in the Straits, and to whom several Tin streams in the Mergui Province were known. These are situated chiefly on the Little Tenasserim river, into which they empty themselves. The first and most accessible is the Thabawliek, which unites with the Thakiet, 3 miles above the junction of the latter with the Little Tenasserim. The mouth of the Thakiet is 11 miles from the town of Tenasserim.

5th. The access to this Tin ground is by land in the dry season. Landing at the village of Thakiet, I proceeded on foot 8 miles, and reached the Thabawliek.

6th. The intervening ground is for the most part flat. After passing a marsh of some extent, there is a low ridge of hills, which presents, however, no obstacle to land carriage of any description. The face of the country is as usual, except in marshy places, thickly covered with jungly trees, but the wild elephant's track is open and convenient. During the monsoon, boats carrying 100 bags of rice can ascend the Thabawliek to the place alluded to, in one day. The tide is felt about 6 miles from its mouth.

7th. Having arrived at the spot at a point known to my guide, and at which he had the previous year stationed himself for a few months for the purpose of collecting Tin, I found numerous pits and old cuttings from which Tin had been formerly obtained. It is found in layers of gravel immediately beneath the soil. The surface is undu-

lating, and during the wet season streams of water could have been conveniently conducted near the excavations for the purpose of washing the gravel.

8th. The guide stated that crystals of Tin could be in this manner separated by the hand without the usual aid of the washing trough. The rains not being at that time sufficiently advanced for that purpose, I did not succeed in obtaining any Tin from the pits. The line of deposit of the richest stanniferous gravel has been probably influenced by many causes, and the chances of finding it are much the same as those to which other undertakings of this nature are subject. A few trials, however, across the low ground through which the hill streams pass would enable the speculator to follow its course.

9th. The time of the Tin-washer was, I found, much better occupied in seeking for Tin in the bed of the river. He was assisted by one man, who disturbed the sand and gravel with his feet to as great a depth as he could thus accomplish, when a conical and shallow trough, about 2 feet in diameter and 10 inches deep, was filled with the same, and washed in the stream by a circular motion so as to get rid of the gravel and lighter particles, leaving the crystals of Tin to collect by their gravity on the apex of the hollow trough.

Each filling and washing occupied on an average 6 minutes:

One washing produced 1,041 *grs.* of native peroxide of Tin in 6 minutes, ...	Specimen No. 2, equivalent to 1 *oz.*, 335 *grs.* of pure Tin.			
One ditto 1,265 *grs.* of ditto ditto, ...	Ditto	No. 3,	ditto	2 *oz.*, 31 *grs.* ditto.
One ditto, 1,785 *grs.* of ditto ditto,...	Ditto	No. 4,	ditto	2 *oz.*, 430 *grs.* ditto.
One hour's work apart from the above produced of 8,166 *grs.*, ditto ditto, ...	Ditto	No. 5,	ditto	13 *oz.*, 160 *grs.* ditto.
Total of half a day's work, including the above, produced 25,406 *grs.*, ...	Equivalent to 2 lb. Specimen No. 6, contains of the latter 13.149 *grs.*			9 *oz.*, 232 *grs.* ditto.

The price of labor in this province is 6 annas per day.

10th. The produce of a day's labor of two men would be, according to the above trial, equivalent to 5 lbs., 2 oz., 464 grs. of pure Tin at the cost of 12 annas, exclusive of the expenses of reduction to the metallic state. This process from the pure state of the mineral is extremely simple and inexpensive. The Tin collected in the trough would require one more washing, to remove particles of sand, &c., and charcoal is the only fuel required for its reduction. The pieces or ingots of Tin in the shape of the frustrum of a cone, Specimens Nos. 7 and 8, which are manufactured at the Rehgnon Mines on the Pakchan river, to the Southward,

and exchanged there for goods at 4 annas each, weigh 1 lb., 2 oz., 383 grains, and their value at Mergui, where the average price of Tin is 85 rupees per 100 Viss of 365 lbs. is 4 annas, 4 pie. The value, therefore, of 5 lbs., 2 oz., 464 grains, or the day's work of two men, would be 1 rupee, 8 annas, 4 pie; the cost of collecting being 12 annas, leaves 12 annas and 4 pie for the cost of the reducing process, and for profit on the labor of two men.

11*th.* On the morning after reaching the Thabawliek, I traced the Tin ground for a mile in a N. N. E. direction. The pits are in some parts more abundant than in others; and I was informed that they occurred and were thickly scattered throughout the entire course of the river between that point and the hills from which it issued, at the distance of an entire day's journey if the windings of the river are followed.

12*th.* The pits have not been worked since the Burmese took possession of the country. At the head of the stream there are said to be the remains of bunds constructed for distributing water for washing the Tin, and the posts of a house still standing, which is supposed to have been occupied by a Siamese Superintendent of the work there carried on.

The season was too far advanced to enable me to prosecute my inquiries towards the hills on this occasion, and my attention was therefore confined to the spot from which I obtained the results detailed above.

13*th.* Four other rivers, emptying themselves into the lesser Tenasserim, are said to produce Tin, but none are so accessible as the Thabawliek.

The following are the names of these streams with their distances from the Thakiet river:

The Thamoung-tang river. One day by the Little Tenasserim and 1 march inland.

Engdan river. No road through the jungle.

Kyeng ditto. Two days by the river and 2 days inland.

Thapyn ditto. Three days by the river and 1 march inland.

From the Thamoung-tang, Specimen No. 9, weighing 2,890 grains, was collected in 10 washings, but I did not visit the place myself.

The size of the Tin is larger than that collected in other places, though the produce is not equal in quantity.

14*th.* After returning to Tenasserim, I visited Loundoungia river, where Tin was said to exist; but it turned out to be Wolfram sand, which had been washed down from the adjoining Slate mountains, and was lying on the surface of the sandy bed of the stream.

15*th*. In proceeding down the Great Tenasserim river, towards Mergui, I halted at Moetong, for the purpose of visiting a Tin ground which was said to exist near the range of hills to the N. E. skirting the open plain in which this place is situated. On penetrating to the hill *itself*, I found it to consist exclusively of granite, with not a trace of another rock of any description. The dry beds of the water-courses consisted of granitic sand alone.

There were many excavations for Tin on the face of the hill; several loads of gravel from the bottom of the pits and from the beds of the water-courses were carried to the river and washed, but the out-turn of Tin was very small. There is no water within convenient reach.

16*th*. The next spot visited was Kahan, a small hill near the Zeda-vaun Pagoda on the right bank of the Great Tenasserim river, 11 miles from Mergui. The Tin occurs here under conditions differing much from that of the localities above-mentioned.

Kahan itself is the highest portion of a low ridge of hills not more than 200 feet above the level of the river: it is composed of a soft, friable, white sand-stone rock, the upper portions of which are decomposed and irregular. The surface gravel does not contain Tin. It is found in the crystalized form, interspersed in decomposed granite, forming a vein about 3 feet wide, which is enclosed by the white sand-stone rock, and dips down at a high angle with the horizon. Specimen No. 10, if its form be preserved, illustrates well the Tin crystals imbedded in the decomposed granite, which are easily detached from the matrix. The Specimen 11, from the same vein, of a yellow color, is considered the surest indication of the presence of the mineral, and lies below the white No. 10; large scales of chlorite occur with it, which, as they are generally found where the Tin is most abundant, is called by the Natives the Mother of Tin. The face of the hill is in one spot scattered over with these, which appear to have been brought down from the vein with other matter from which the Tin has been separated by the usual mode of washing. It will be noticed that the granite is completely decomposed, and that the crystals would be easily separated by washing. No Tin has been raised here since the country came into our possession, but the locality has been known. It was worked during the Burmese rule, and valued as supplying the richest ore of Tin. A Burmese, residing near the spot, pointed out the place where his operations had ceased; he had followed the direction of the vein alluded to, as well as he was able, and had driven a gallery under ground in an

inclined direction upwards till the bank above fell in, when the mine was abandoned. He stated that he had procured considerable quantities of Tin daily, and that he often found it in large masses mixed with the yellow ground above-mentioned. Arriving at the spot where his work had terminated, I set people to excavate and find, if possible, the vein which had been described. It was reached after about 2 hours' digging, at the depth of 5 feet from the surface of the cut in the hill in which we stood. In about a quarter of an hour a few baskets of the decomposed granite were removed down the hill, from which 3,900 grains of the crystallized peroxide of Tin, equal to 63,176 grains of pure Tin, Specimen No. 12, were collected, and the next day 23,400 grains, equal to 2 lbs. 6 ounces, and 100 grains of pure Tin were found in the same manner by one man's labor in excavating, one carrying down to the water, and a third washing.

17*th*. This locality appears to be of a very promising description, and I have little doubt that, if the work were aided by ordinary skill and means, a Tin mine here would be productive. A vein of Tin is, in fact, exposed to the day, and would only require for a considerable period of work the precaution of well-supported galleries and shafts to allow of its contents being easily extracted.

The Kahan hill is, I conceive, an indication of a valuable repository of Tin. It is but a quarter of a mile from the creek communicating with the river, which is accessible to any boats. Its proximity to Mergui offers also great facility for the procurement of labor and supplies.

18*th*. The localities, therefore, which appear to hold out the best prospect for Tin are, 1st, for Stream Tin, the Thabawliek river and the Thengdan river; and for Mine Tin, the Kahan hill. They all produce Tin of the same nature and quality, *viz*. crystals of the native peroxide, being a combination of oxygen and Tin only.

19*th*. No difficulty would be found in procuring labor from Mergui for carrying on Tin works at either of these places.

20*th*. The location of the Coal mine on the Great Tenasserim river has given rise to much additional cultivation along the banks of that river, where there are many Kareen villages, from which parties on the Thengdan could be supplied. Fruit trees not indigenous to the place, and other traces of a considerable population having once occupied its banks, are observable on this river. The banks of the Little Tenasserim are thinly occupied by Siamese villages. The country in this direction, except near the banks of the river, is utterly unpeopled and appears always to have been so.

Of the existence of Tin in considerable quantities, there cannot, from the facts above stated, be much question, and from the trial of the produce of one man's labor in a given time, there appears to be sufficient to justify every expectation of a profitable employment of labor on an extensive scale.

The results, however, which are given in detail can only be considered rough approximations to the probable out-turn of Tin with an establishment properly superintended. Much economy in labor might be effected in collecting the sand and gravel for the washers, but no better mode could, I think, be adopted in separating the Tin in the first instance than by people accustomed to work with the flat conical-shaped troughs before described. The quantity collected would fully repay the employment of men in this operation.

The Tin as produced by the washers should be placed on sloping boards, and water conducted over it from a trough pierced with holes for the purpose, in order to get rid of foreign particles; and it would then, after being finely pounded, be ready for smelting. Of all metals Tin is in this process the least troublesome after the ore is freed from the earthy and silicious particles with which, in other countries, it is often mixed. The crystallized form, in which the ore is here found, renders its separation extremely easy, and the whole processes of stamping and dressing, which in England are tedious and expensive operations, can thus be dispensed with. No arsenic or sulphur being mixed with the ore, it need not be roasted before it is placed in the furnace.

It will thus be seen that the Tin of the Mergui Province offers no ordinary inducement to the outlay of capital without much of the risk, uncertainty, and large previous outlay usually attending mining adventures.

21*st*. Communication by water from the Thakiet to the Thabawliek Tin ground is not open in the dry season, but the distance by land is short. The produce of two lines of country, that of the vicinity of the Great and Little Tenasserim rivers, passes the Town of Tenasserim at the junction of these rivers, only 11 miles from the Thakiet, and no difficulty in procuring subsistence for working parties on the Thabawliek need be apprehended.

G. B. TREMENHEERE, *Captain,*
Executive Engineer, Tenasserim Division.

MOULMEIN,
The 31*st August*, 1841.

REPORT

ON THE

MANGANESE OF THE MERGUI PROVINCE.

BY

CAPTAIN G. B. TREMENHEERE,

EXECUTIVE ENGINEER, TENASSERIM DIVISION.

DURING my stay at the Tenasserim Coal Basin, a piece of Manganese ore, black wad, of good quality, was brought to me by a Kareen, who stated that it had been found accidentally in the bank of a stream called the Thuggoo, which enters the Great Tenasserim 17 miles below the coal site. Subsequently several other pieces of the same ore were brought by Mr. T. A. Corbin, Assistant to the Commissioner, from the Therabuen river, 5 miles above the Thuggoo, and from an intermediate spot, the locality of which had been previously known, and had been, I believe, originally pointed out by Lieutenant Glover of the Madras Army.

2nd. In proceeding down the river I visited these spots, and found at each that a valuable bed of Manganese ore existed close to the surface of the country. It had been apparently cut through by the action of the streams and river before-mentioned, leaving a section of the bed of ore in their banks covered only by the *debris* of the banks themselves. Large quantities might have been carried away, but a few hand specimens only were taken, which sufficiently show the nature of the deposit, and are fair samples of what might be easily collected.

3rd. The best Specimens, Nos. 1 and 2, are from the Thuggoo river and the bank of the Great Tenasserim. That of the Therabuen did not appear to be at the surface of so pure a quality, but the existence of the bed being known, it is perhaps premature to pronounce it an inferior ore from the examination of specimens taken from a hole extending not two feet into the bank. No. 5, is a portion of Manganese rock projecting into the Great Tenasserim river near the mouth of the Therabuen stream.

4th. Of the extent of these Manganese beds, it is difficult to pronounce. The face of the country in which they are situated is flat, thickly overspread with soil and with the densest jungle. It is not, as far I could perceive, intersected by many streams which would afford the means of tracing the mineral deposit. The Great Tenasserim river has passed through the Manganese bed in one spot, 2½ miles removed from two other points at which it occurs to the North and South, at both of which it is likewise discovered near the surface by the action of the streams Thuggoo and Therabuen. The probability, therefore, is that it is a horizontal deposit covering many square miles. But without indulging in conjecture, there is sufficient at the localities referred to, to indicate large quantities of Manganese ore, which could be collected by penetrating through the soil lying above it and immediately near the spots, in which it is now exposed to the day.

It occurs in the form of the black oxide, and is the Manganese of commerce. It is largely consumed in Europe in the preparation of bleaching compounds, and, when pure, is valuable to the manufacturer of glass.

5th. The soft black ore No. 1, is a hydrate of the peroxide of Manganese, known under the name of Wad. It contains of water two equivalents, or 29 per cent.

Iron 1·96 grains by analysis. Its specific gravity, is 1·47
The specific gravity of the grey peroxide No. 4, is 2·46

G. B. TREMENHEERE, *Captain,*
Executive Engineer, Tenasserim Division.

MOULMEIN,
11th September, 1841.

To. G. A. BUSHBY, ESQUIRE,
Secretary to the Government of India,
General Department.
&c. &c. &c.

SIR,

In reply to your letter of 24th ultimo, No. 1684, I have the honor, under instructions of the Coal and Mineral Committee, to say that the specimens of peroxide of Tin received from the Tenasserim Provinces, are the usual ore of Tin, which is worked with much advantage in the Dutch Possessions in the Straits, and in the lower parts of the Malay Peninsula, South of the British boundary; but it has not hitherto

been supposed to be sufficiently abundant on the Coast, to be profitably worked beyond the tenth degree of North latitude.

2nd. The importance of this ore depends entirely upon the quantity in which it occurs; the most profitable repositories are those in which it is found in the form of crystals in soft gneiss. It is often, however, profitably obtained from the sands of rivers, when it is called Stream Tin ore.

3rd. The Tin occurs as stream ore in all the localities described by Captain Tremenheere, except Kahun, a hill on the right bank of the Great Tenasserim, about 11 miles from Mergui, vide Paragraphs 16 and 17 of Captain Tremenheere's Report. Here Captain Tremenheere found the ore in its native repository, a friable gneiss rock, similar to that in which it occurs at Banka.

4th. The Committee are of opinion that the circumstances brought forward by Captain Tremenheere in the 16th and 17th paragraphs of his Report, are such as to render it desirable that the miner recently employed in Kemoon under Captain Drummond should, if now available, be placed under the orders of Captain Tremenheere, for the purpose of ascertaining the value of the ore at Kahun.

5th. I have the honor to return the specimens as directed, for the purpose of being presented to the Asiatic Society, having, however, retained a portion of each for the Committee's collection of minerals.

I have the honor to be, &c.,

J. McCLELLAND,
Secretary to the Coal Committee.

CALCUTTA,
The 15th December, 1841.

Extract from a letter from the Hon'ble the Court of Directors to the Government of Bengal, in the Public Department, No. 20 of 1843, dated 25th October, 1843.

PARA. 10. The specimens of Tin ore received from Mergui have been examined by several competent persons in this country, who consider them to be of the best kind. As a profitable speculation every thing must depend upon the expense at which this ore can be prepared for the market. According to Captain Tremenheere's Report it can be procured in abundance and at a cheap rate.

15-16. Forwarding Reports by Captain Tremenheere on the Tin Grounds and Manganese Beds of the Mergui Province.

No. 30.

FROM MAJOR A. BOGLE,
Commissioner, Tenasserim Provinces,

To J. P. GRANT, ESQUIRE,
Secretary to the Government of Bengal,
Fort William.

DATED MOULMEIN, 21ST JUNE, 1850.

SIR,

It is generally understood that there are in the Provinces of Tavoy and Mergui rich deposits of valuable ores, and that in Mergui in particular there are extensive Coal fields, one of which, but not the best, was a few years ago the scene of some limited operations, but at no time has any minute or scientific examination been made into the extent or value of these resources, by persons possessing full leisure and in all respects qualified to undertake the task, and it is now generally asserted that the Coal-mining operations were discontinued just at the time when very superior Coal had been discovered, and they promised most favorably. The importance of ascertaining something more of the mineral resources of the Southern portion of these Provinces, and of the numerous islands in the Mergui Archipelago, appears to me not to admit of any question, and I would particularly solicit attention to the great saving which might annually be effected to Government, and the great advantage which would accrue to these Provinces should it be found practicable to discontinue the importation of Coal, and to supply the Government Steamers, and, probably before very long, private Steamers also plying between Calcutta, Ceylon, and the Straits, with safe and economical fuel. I am aware that objection was formerly taken to the Coal of Mergui on account of its tendency to spontaneous combustion, but I am given to understand that the Coal to which this suspicion attached was not extracted from the best mine; it certainly does not at all follow that because some specimens have been found to contain dangerous properties, the entire Coal of a Province should be equally unfit for use, and that because some parcels have ignited under suspicious circumstances, that combustion proceeds entirely from the quality of the Coal.

2*nd*. As a proof of the fallacy of such an argument, I may mention that some hundreds of tons of Coal imported from England and Scotland have been consumed in the depôt at this place, within the last few

years, yet no one has ever thought of attributing the fires solely to the peculiar properties of the Coal.

3*rd*. The expense of importing the quantity annually required for the service of this port, does not fall short of rupees 30,000, a sum which if expended within the Province might be productive of much good.

4*th*. But it is not merely to the Coal deposits, valuable as they are believed to be, that I would direct attention; it is well known that there is excellent Iron and Tin in the Southern Districts: it is believed that Copper is also to be found, and probably Lead and Silver may likewise be discovered.

5*th*. It is also well known that one of the first elements of success in the development of mineral riches exists in the highest perfection, *viz*., water carriage; the numerous streams are navigable for a considerable distance, and the Islands may be closely approached on all sides by vessels of large burthen; indeed few countries are more favorably situated in this respect than the Tenasserim Provinces, yet the whole coast is neglected, and the very extent of our territory is still a matter of doubt.

6*th*. I have no intention of recommending at present that mining operations should be renewed on the part of Government, but as it is well known that an extensive steam communication is about to be established in the Eastern Seas, and such communication must inevitably increase with the progress of time, I consider it my duty to draw the attention of Government to the importance and expediency of causing the resources of the Southern Districts of these Provinces, which are believed to be the most rich, to be carefully examined and reported on, in the expectation that should the results be favorable, the great Steam Navigation Companies or other Capitalists may be attracted to localities which seem to be most conveniently situated, and although I have no Assistant who is capable of conducting an inquiry of this nature, I am happy to say that should the Government approve of the suggestion, the services of Mr. E. O'Riley, who has long resided in these Provinces, and possesses much information respecting them, and probably sufficient knowledge of Geology and Mineralogy to admit of his furnishing a valuable report at a charge of perhaps not more than Rupees 500 per mensem, including travelling expenses, are available. Mr. O'Riley is the same gentleman whom I lately recommended for employment on a mission to the Shan States, but doubts may well be entertained whether the state of affairs in that direction may at the beginning of the cold

season admit of his proceeding to Zimmay with any prospect of benefit to commerce.

7th. Feeling convinced of the importance of ascertaining more of the resources which are believed to exist within these Provinces than is at present known, and of the incalculable advantages which might result to this jurisdiction from the facts being made known to the world at large, I beg to recommend that the opportunity which presents itself of obtaining much useful information at small cost, by employing Mr. O'Riley, may not be permitted to escape. I should think that Rupees 500 per mensem, including travelling charges, would be a fair rate of remuneration, and the period of his deputation would not exceed 3 or 4 months.

I have the honor to be, &c.,

A. BOGLE,
Commissioner, Tenasserim Provinces.

No. 83.

FROM MAJOR A. BOGLE,
Commissioner, Tenasserim Provinces,

TO J. P. GRANT, ESQUIRE,
Secretary to the Government of Bengal,
Fort William.

MOULMEIN, 21ST AUGUST, 1850.

SIR,

With reference to my letter to your address, No. 30, of the 21st June 1850, I beg to state that when Captain Berdmore was lately here he brought to my notice the circumstance of some rich specimens of Tin ore having lately been discovered at an entirely new place not far from Mergui, and of some peculiarly favorable indications of the existence of a highly bituminous and valuable description of Coal at a place which has never yet been explored.

2nd. I therefore think it proper to bring the same to the notice of the Hon'ble the Deputy Governor, in further illustration of the advantages which I anticipate from the employment of Mr. O'Riley on special survey of the Southern parts of these Provinces.

3rd. Our great want is population; the people who are most likely to emigrate from the countries South of Mergui are the Chinese, who are now stated to be almost too numerous in the Straits, and nothing is more likely to bring them than authentic information of the existence

of good Tin, Coal, and Iron deposits: with an increase of population the developement of all our resources may be hoped for. I therefore trust the Deputy Governor of Bengal will afford me his support in the moderate and inexpensive scale of experimental operations, which I have been induced to recommend.

I have the honor to be, &c.,

A. BOGLE,

Commissioner, Tenasserim Provinces.

No. 235.

FROM MAJOR A. BOGLE,

Commissioner, Tenasserim Provinces,

TO J. P. GRANT, ESQUIRE,

Secretary to the Government of Bengal,

Fort William.

MOULMEIN, 14TH FEBRUARY, 1851.

SIR,

I have the honor to transmit herewith copy of the communications noted in the margin* being a Report from Mr. O'Riley, of Moulmein, on an excursion which he lately made from Tavoy to this place, in search of Copper and other mineral resources, with a memorandum on the specimens submitted by him and which are forwarded in a box addressed to you; likewise his Report on the Bay of Henzai, which is situated between this place and Tavoy, but, although so close to Moulmein, does not appear to have hitherto attracted any attention.

* No. 1. Letter from E. O'Riley, Esq., to Major A. Bogle, Commissioner, T. P.

No. 2. Memorandum on Mineral Specimens.

No. 3. Report on the Henzai Basin, its Streams, and the Country in its immediate vicinity.

2nd. When I was at Tavoy in November last, I had the pleasure of meeting Mr. O'Riley there, when he communicated to me the result of a journey which he had lately made through the jungles, from Tavoy to Mergui, and also of an effort he had just returned from, to reach Henzai Bay overland, but in which he had failed, when on the very point of accomplishing it, from want of supplies, his means of carriage having been entirely deficient.

3rd. As it appeared to me that there were strong reasons for believing that an examination of the country in the vicinity of Yé and between it and Moulmein would result in the discovery of Copper, if

not of the more precious metals, and that the numerous streams which fall into Henzai Bay merited attention, from their reported richness in Tin, I felt an earnest wish to avail myself of Mr. O'Riley's energy and intelligence before the cold season had passed away, I therefore took it on myself to make him an advance of Rupees 500, merely to enable him to hire an elephant and coolies and lay in common necessaries for the journey, his own funds having been exhausted; and the Reports and specimens I have now the honor to submit are the result. I would of course have much preferred awaiting His Honor's sanction to the above outlay before making it, but had I done so I feared that the season might expire and the opportunity be lost; I trust the Deputy Governor will approve of my having supplied Mr. O'Riley with the requisite means of carrying out, in some degree, the examinations I wished to have made.

4th. On his report it is difficult to arrive at any very satisfactory conclusion, and the subject is one on which, without a personal visit to the places inspected by him, I am reluctant to express any opinion, but I feel confident that Mr. O'Riley has followed up his inquiries, as far as his means would admit, with much zeal, and perseverance, and it is very certain that he has encountered much fatigue and privation, travelling chiefly on foot and without camp equipage, and subsisting for the most part on the simple diet procurable in the villages. He has indeed proved himself possessed of all the activity and hardiness calculated to ensure success in overcoming the numerous serious difficulties incident to attempts to explore regions covered with the densest jungle, and his Reports contain useful information, and display much ability and intelligence.

5th. Of the ultimate discovery of auriferous deposits of any extent or value, or of even Copper, I am far from being sanguine, although it would appear that both exist in a limited degree, and also Lead and Silver, but the existence of valuable Tin in some quantity in the streams which fall into Henzai Bay, may, I think, be viewed as an established fact, in proof of which I submit a sample smelted at this place, which appears to me to be very superior indeed. Some new deposits of Coal, very favorably situated, have also been lately discovered in the Mergui district, of which I hope to be able to furnish some fine specimens hereafter, and these added to the fields already well known on the banks of the Tenasserim river, and the rich Tin mines, long since discovered on the Pakchan, the Southern boundary of the Province of

Mergui, may, I think, be regarded as satisfactory evidence that we possess mineral resources of considerable value, and that further search and inquiry may reasonably be entered on, in the expectation that discoveries of much greater importance will be the result.

6th. It is also most satisfactory to know that Mr. O'Riley found Teak trees in the line which he traversed, as in the event of the Government at some future period undertaking to plant Teak here, as is now being done in the Madras Presidency, it is very desirable that the most favorable country should be known.

7th. With respect to the Copper scoria found by Mr. O'Riley, not far from Moulmein, I lost no time in instituting further inquiries, but I have not yet been able to ascertain either the object of the smeltings which appear to have been carried on at some remote period, or whence the ore was obtained; the matter, however, still has my best attention, and I trust I may yet hear some good accounts of it.

8th. To Mr. O'Riley's Memorandum on his specimens, I beg leave to solicit very particular attention, especially to the concluding part, which has reference to the Coal deposits, and I would earnestly recommend that all the specimens be submitted to the examination of the best Geologists at hand, and that I may be favored with His Honor's instructions respecting the further prosecution of mineralogical inquiries in these Provinces. I am not sufficiently acquainted with the subject to hazard any definite remarks upon it, but I may observe that Mr. O'Riley's Reports have in no way dissipated the expectations I entertained when, under date the 21st August 1850, I recommended his employment in this very interesting field.

9th. On paper No. 3, descriptive of Henzai Bay, I have but little to say, except that I am informed by others that the entrance is by no means so bad as Mr. O'Riley represents, there being a very sufficient channel for vessels of considerable draught, and within the last few weeks I have received three applications for waste lands on the margin of the Basin from Europeans who purpose to establish settlements there. These applications are in course of being complied with under the provisions of existing rules, and it really appears to me that if such Tin as that which accompanies this letter is procurable there, in any abundance, the grantees may be very successful.

I have the honor to be, &c.,

A. BOGLE,

Commissioner, Tenasserim Provinces.

P. S. Since the above was written, I have received from Tavoy some specimens of magnetic Iron ore and Tin ore collected by Mr. O'Riley, and I now do myself the pleasure to forward them.

I beg to state also, that by this mail I have received an application for a grant of land from three gentlemen in Calcutta, who are anxious to work for Tin near Mergui, which I hope is only the precursor of other applications of a similar nature.

If it could be made convenient to make Mr. O'Riley's papers public, and to place his specimens within the reach of capitalists, I think it probable that the interests of these Provinces might be advanced thereby.

A. BOGLE,
Commissioner, Tenasserim Provinces.

No. 1.

To MAJOR A. BOGLE,
Commissioner, Tenasserim Provinces,

DATED MOULMEIN, 17TH JANUARY, 1851.

SIR,

Agreeably with the wish you expressed when at Tavoy, that I should extend my examination of the provinces in continuation from Mergui to the streams of the Henzai Basin, I have the honor to submit the following particulars of my route to this place, overland from Tavoy, for your information, together with the accompanying Reports on mineral specimens, and the Henzai Basin.

2nd. From Tavoy I proceeded to make a second examination of the gold washings in the streams which feed the Tavoy river in the vicinity of "Kalein Owng," my previous visit to this locality having been during the South-west Monsoon when the water had attained its highest point, and greatest strength of current; I regret to state that the same causes operated on this second occasion, to prevent a thorough examination being made: the streams being still too deep to admit of the water-courses being properly examined; I ascertained, however, from the Karens located in the vicinity, that the Shans never visit the locality before the end of the present month, when the water-courses have sufficiently drained to admit of being worked profitably.

3rd. The only streams worked periodically (from January to June) are

1. The Dzin Bah Choung above, and

2. The Eem Bah Choung below the point of Kalein Oung, from which the produce per man for the month's washing was stated to be from three mats to two ticals of gold dust. This would give a fair average of $1\frac{1}{4}$ ticals per man for the month's labor, at a valuation of 28 to 30 Rupees per tical, according to the quality of the gold; the correctness of this statement may, however, be questioned, as it is not probable that the Shans would cross the frontier from the Siam border provinces for so small a rate of remuneration, nor is it to be expected that they would communicate to the Karens the actual amount obtained. The examination of the upraised formations, afforded no data by which to judge of the existence of any of the gold-bearing strata, and from the smallness of the party employed in its collection, and only at the localities stated, I think the inference is warranted that it is partially and scantily distributed, at a distant part of the streams; and not of sufficient importance to induce the employment of capital in its more extended development.

4th. From the sources of the Tavoy river, I proceeded across the range of mountains to the examination of the streams which descend from their Western sides into the Bay or Basin of Henzai; passing through the country formed by the base of those mountain ranges; and, after the examination of the whole of the minor streams on the Western water-shed, I descended the main stream, which enters from the South into the beautiful Basin of Henzai. The result of this investigation I have the honor to submit in the separate form No. 3, in addition to which I have merely to state, that its natural advantages are such as to secure for it, at no distant period, a place in the scale of importance second to none in the provinces, provided efficient measures be adopted to bring forward the vast mineral resources to which it is the key.

5th. As stated in my remarks on the specimens of Tin, Gold and Copper, it was in one of the small streams which fall into the Henzai Basin that I discovered the existence of these metals, and in explanation of the steps I took to carry out to the full its exploration, I may here state, that my party consisted of but one elephant and six men, and that having been prevented from ascending the stream by its bed, owing to the numerous rapids and deep pools, which are not fordable before the end of the present month (January,) I there attempted the passage by land, keeping the course of the stream; but after two days

of excessive labor I had not progressed more than five miles from the point of starting. The fallen bamboo jungle, which covers the whole face of the country, proving a complete barrier to our progress, and until opened by the annual fires which spread through the jungles during this and the next month, without more ample means than I possessed, it were perfectly impracticable, but, from February to May inclusive, the country will have become more open, and the streams much reduced, when, if considered desirable, a more effectual exploration can be instituted.

6*th.* Leaving Henzai, by its Northern stream, I ascended to the hilly region to the eastward of Yé, where my Karen guide informed me that a deposit of Copper ore had been discovered some 10 years ago. After an unavailing search for six days, and owing to the provisions being exhausted, I was compelled to abandon the search, and descended the Yé river from its source on a bamboo raft, to the old Town of Yé. That nothing should be wanting to induce a further search, I distributed specimens of Copper ores to the Karens, and engaged a party to proceed again to the hills, after obtaining a supply of rice and other necessaries, and I have every reason to hope that a more successful result may be shortly attained.

7*th.* In my route across the country from Henzai to Yé, I met with a considerable number of teak patches, the serviceable trees of which appear to have been exhausted a considerable time since; the full grown trees remaining are few in number and worthless, but in their vicinity are many young trees of good growth; in greater abundance are the Henzai Khowngs which, with trifling attention in keeping them clear of the surrounding jungle, will afford at maturity a very desirable supply of good timber.

8*th.* From Yé I proceeded by the old road from Moulmein to Tavoy, which skirts the hills, and known as the "Daing Koon" road: the various localities examined, afforded no evidence of metallic or other valuable mineral deposits, but, at a day's march from Moulmein, near the Talain village of Kyiek Myraw, I discovered several heaps of "scoria" buried in the alluvium, upon which a high jungle had grown; its examination showed it to have been the refuse from smelting furnaces in which Copper ore had been reduced (see Specimens and Remarks).

The third deposit of the kind I discovered.

9*th.* I made every inquiry on the spot as to the locality of the ore; but it would appear that subsequent to these metallic deposits having

been worked (during the Birman supremacy) the whole of the population of these provinces was removed, and many thousands absconded into Siam, so that it is a very rare occurrence to find a man who has resided in the particular locality, possessing any local knowledge anterior to our taking possession of the country; added to which, is the almost insuperable objection which exists with both Talains and Karens to disclose the existence of any metallic deposits known to them, thus rendering the exploration of the interior more arduous than is generally supposed.

10*th*. The existence of "Copper scoria" at three distinct localities between Moulmein and Mergui, is a substantial proof of the existence of that metal in the provinces to a valuable extent, and as it is not probable that the veins originally known to the Burmese were exhausted or worked to any considerable depth below the surface, it may be expected that, with the aid of a proper establishment, and guided by scientific data, its locality could be ascertained without much difficulty, and unattended with any expense commensurate with the vast importance such a discovery would prove; but this should be undertaken during the present dry season, ere the rains of the South-west Monsoon clothe the surface with its annual jungle, and change the streams into mountain torrents.

11*th*. I regret that the mineral specimens forwarded during my route to Tavoy should not have arrived, to have enabled me to report more fully on that subject, but this can be done on their arrival, should it be deemed desirable: I also possess information from native sources, which, if correct, would prove exceedingly valuable, but in its present crude state, or until I have tested its correctness by personal investigation, I hesitate to lay it before Government.

12*th*. In conclusion I have to make my acknowledgments for the timely assistance you afforded me, to enable me to carry out my observations as herein stated; and with the regret that I feel at not being more successful, I have to express the hope, that, under the circumstances, you have tenable grounds for satisfaction in the result.

I have, &c.

E. O'RILEY

No. 2.

MEMORANDUM

ON

MINERAL SPECIMENS.

STREAM TIN ORE.—These specimens form the quantity collected on the various streams which empty themselves into the Henzai Basin from the South through the main stream of the "Oung Beng Quin." In regard to quality, it occupies the same position in its classification as the peroxide of Tin (ore) the produce of the Banka mines, the pure metal of which bears the highest value in the home markets.

NOS. 1 AND 2 STREAM TIN.*

It may be necessary to state that the quantity forming the present specimens, was obtained by washing the sand taken out of the streams which I crossed in my route through the country to the South-east of Henzai, and having no time to spare in freeing it entirely from the sand which accompanies it, the mass may contain from 30 to 40 per cent. of foreign matter, and as it is not likely that the Natives will bestow more care upon the collection of the ore than that bestowed upon this, it may be considered a fair sample of the Stream Tin of those localities, which, with a proper process of reduction, will produce of pure Tin from 55 to 60 parts in 100.

Having, from want of more efficient means, been compelled to confine my examinations of the different localities to the beds of the streams and the sections in their banks, it may not be expected that I can speak decidedly as to the depth or extent of these Tin beds; to obtain such data would require a procees of sinking shafts in the "alluvium," on to the Tin deposits which occupy the whole surface of the country on a level with the base of the hills, and which must, at a remote period, have formed the water-courses into the sea; by such a method of explora-

* The larger specimens sent to Tavoy to be forwarded per "*Proserpine.*"

tion, the extent and richness of the Tin beds, would be ascertained, but from the comparatively short time occupied in obtaining the quantity now forwarded, as well as from the information of the Natives who occasionally wash these streams for both Tin and Gold, it would appear that from 6 to 8 lbs. of clean ore can be obtained by a woman during a broken day's work, and for a regulated system of labor by competent men, double that quantity, or from 18 to 20 lbs. of ore, may reasonably be expected as the produce; in excess of which, I am prepared to state, that neither the richest deposits in the Malay Peninsula nor those on the Island of Banka have ever produced.

"PEROXIDE OF TIN."—This small specimen of Tin ore demands more particular notice, from the circumstance of the larger portion of it being formed by a mass of crystals of Tin-stone, giving evidence of the existence of a Tin lode in the formation washed by the mountain stream in which I procured it, and more especially so as, on examination of the mass at the end of the day's journey, I found it to contain the accompanying specimens of Copper and Gold.

No. 3, LARGE WATER-WORN CRYSTALS OF TIN-STONE.

No. 4, "COPPER." No. 5, "GOLD."

In my letter accompanying, I have detailed the circumstances connected with the discovery of this very interesting specimen, and its accompanying more valuable metals; it is only necessary, therefore, to remark here, that the position at which I found these specimens, being considerably above the level of the streams from which the other stream ore was obtained, in a tract of country, in fact, showing a decidedly metalliferous character in the upraised rocks of the older formations, from which the greater portion of the mineral wealth of Cornwall, Tin and Copper, is derived, leads to the hope, that by prosecuting a minute search in the upper portion of the stream, when the waters have sufficiently subsided to admit of doing so effectually, the Tin lode *in situ* may be discovered, and with the same object that of exploring the locality for the "*Gold and Copper*" deposits would be associated.

The unusually large size of the grain of Gold, induces the opinion that some section of the water-course, above the position at which it was found, contains a line or vein of "auriferous quartz," from which it has been separated by decomposition of the matrix, and that rich deposits exist in its immediate vicinity. The same remarks apply to the two small specimens of Copper, and the question as to their form of native metal may, for the present, rest either with the supposition that they

formed portion of a vein of native metal, which in filamentary ramifications is found in the transition schists and slates accompanying the granite, or in the shape of a rich carbonate ore of the metal, has been reduced by the action of the fire which sweeps across the surface of the jungles annually.

The discovery of either of the foregoing deposits, it is almost unnecessary to state, would be of the most vital importance as affecting the prosperity of these provinces, and that the three combined in the same locality would form the basis of mining operations, which would command the immediate attention of the capitalists at home, to the speedy improvement of our at present limited and declining resources.

Nos. 6, 7 and 8, Copper Scoria.

These specimens of Copper Slag were obtained by me from three different localities occurring between the mouth of the Tavoy river and Moulmein.

No. 6.—On a small range of hills, forming the Southern bank of the Tavoy River, and near the entrance of the Toung Byouk river, I found the evidences of old smeltings both of Iron and Copper; the surface soil being mixed up with the "scoria" of both those metals, the latter, however, predominating. From an old Talain I heard, that the ore was procured in the vicinity of the slag deposits, but as the period of working occurred during the occupancy of the Birmans, upwards of 30 years ago, the exact position of the former excavations could not be ascertained, the surface having been burnt and, used for "Toung Ya" plantings on several occasions since that time, so that the surface has become uniformly level, and encumbered with decayed and decaying vegetable matter; I was enabled, however, to trace the original position of a large vein in the main formation, which, cleared out, would, I have no doubt, reveal the Copper deposit at no considerable depth, as small fragments of the rock, which I found on the site, gave sufficient evidence of having been originally in contact with an ore of Copper.

No. 7.—This specimen was procured from the alluvial deposits on the banks of the "Oung Beng Quin" stream, the main stream, which, as before stated, enters the Henzai Basin. Its character was perfectly unknown to the natives in that quarter, nor could they afford me the slightest information regarding it. It originally formed the surface out-crop of some ore of Copper in the vicinity, but without instruments or people to enter into a more particular search than that afforded by the stream and its banks, I could not enter upon a more minute search for the precise locality of the deposits.

No. 8.—To the locality from which this specimen was obtained, I would respectfully urge the immediate attention of Government in a further exploration for the site of the Copper deposit. Near the village of Kyiek Myraw, barely a day's journey from Moulmein, I came upon three separate mounds of "scoria," from which the specimen was taken, but neither as to the period of its collection at that spot, by whom worked, or the locality from which the ore was obtained, could I obtain the slightest information; and from circumstances connected with my late tour which rendered me quite incapable of following up the inquiry and examination of the vicinity, I can at present afford but this slight notice regarding it. The metalliferous lime-stone presents itself at a short distance from the site of these "scoria" heaps, and I have no doubt but that a continuous search in that direction would bring the site of these former workings to light if conducted upon known scientific data.

No. 9, Coal from the Little Tenasserim.

Slate Coal.—This specimen, with the one following, was obtained through the Agency of Captain Berdmore, during my stay at Mergui. The general report upon this deposit appeared some years ago in the papers of the Coal Committee, where its good qualities are noticed. The present specimen is much inferior to others obtained from the same locality; the reason being, that the natives who brought it in, took the broken pieces from the surface, to avoid the labor of digging for others in a portion of the seam less exposed to the atmospheric influences; in its present state, however, more especially in its freedom from any "pyritous" matter, it gives ample evidence of possessing a large proportion of "bitumen," rendering it well adapted for steam purposes; and as it presents four or five out-crops, at considerable distances from each other, it may be concluded that the deposit in question forms a portion of the true Coal Basins, from which an inexhaustible supply of good Coal may be obtained. The facilities for its extraction, however, have still to be ascertained, and until this be effected, a more complete report is impracticable.

No. 10, Coal from Lenya.

Cannel Coal.—This specimen, it will be seen, shows small veins of a highly bituminized Coal, dispersed through a clay matrix, the latter, from the excess of pure bitumen it contains, being rendered combustible.

From the information obtained from the native who brought it in, it would appear that the locality is near the head of the "Lenya" river,

considerably nearer the sea coast and in closer proximity to water carriage than the deposit on the upper waters of the Little Tenasserim; the specimens were taken from a large mass out-cropping on the surface, which appears to lie in immediate contact with the richer seam below; the natives, however, being totally unacquainted with the nature of such deposits, and satisfying themselves merely upon its inflammable property, did not go below the surface for purer specimens. Its exploration, however, is desirable, as, in the event of the subordinate strata containing seams of such a magnitude as to render their being worked advisable, a supply of the finest blazing coal in India will be secured, and from its vicinity to water carriage and the coast where a depôt could be formed, it may be expected that its cost will be less than that at which the supplies from the Burdwan and other mines are received.

Having despatched the bulk of my specimens by way of Tavoy to be forwarded from thence by the "*Proserpine*," which vessel has not proceeded to Tavoy in the interim, they are at present unavailable for report upon. In addition to the larger specimens of Stream Tin, the collection comprizes several specimens of "Lead ore," (Galena,) from localities to the Southward of Tavoy, one of which may be classed as an "argentiferous Galena," containing a considerable per centage of Silver, which with an analysis by the proper authority, would, in the present plethora of unemployed capital in England, claim immediate attention in its development.

There are also bulky specimens of a "Native Iron," highly magnetic, which I found in the vicinity of the Tavoy river, but from the difficulty of access to the site, and excessive hardness of the matrix, its extraction by Native means would afford no encouragement as a profitable operation.

EDWARD O'RILEY.

MOULMEIN,
15*th January*, 1851.

No. 3.

REPORT

ON

THE HENZAI BASIN;

ITS STREAMS,

AND THE COUNTRY IN ITS IMMEDIATE VICINITY.

THE entrance into "Henzai" from seaward, according to Captain Lloyd's survey, lies in latitude 14° 43′ N. or about mid-distance between Yé and Tavoy. It has been for many years past a place of resort by the Natives during the dry season, for the purpose of catching the fish (which abound in its wide Basin) which, with the deer and other wild game of its forests, is cured on the spot and brought to Moulmein for sale.

2nd. A reference to the annexed rough sketch, which, having been made without the aid of instruments, has no pretension to a survey, and is only intended to show the general conformation of the locality, will show, that the Basin is fed by streams from the interior, which drain the system of hill ranges stretching in a North and South direction along the coast: these streams to the South, which fall into the larger one of Oung Beng Quin, are occasionally washed for their Tin ore by the few villagers located on the main stream, but only it would appear by the females, when otherwise unemployed, the small amount of Tin ore so collected being disposed of to the Chinese at Tavoy, who smelt it for the Tin.

In traversing the country South of the hill systems before stated, or those which shed their waters into Henzai, I found the streams more or less containing Tin with an admixture of Wolfram or "Tungstate" of Iron, a continuation, in fact, of the same deposits which occur almost uninterruptedly from the Pakchan to the point above stated; here, however, the geological features of the country become changed and show a disposition more "metalliferous" than that further South: hence the stream ore and larger crystals of Tin-stone noticed in paper No. 2 are purer than any procured from localities to the Southward.

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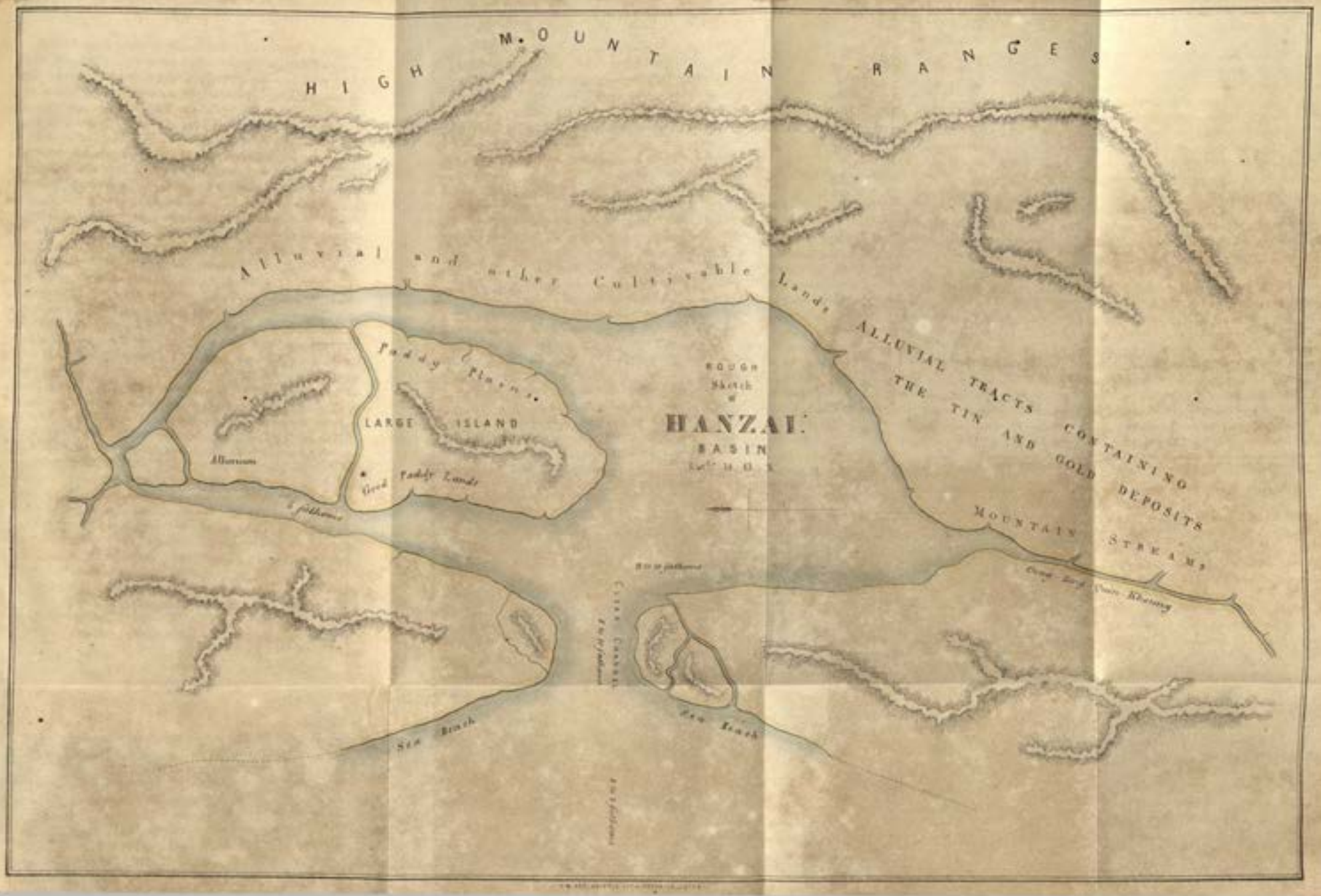
HIGH MOUNTAIN RANGES
Alluvial and other Cultivable Lands
ALLUVIAL TRACTS CONTAINING THE TIN AND GOLD DEPOSITS
MOUNTAIN STREAMS
Paddy Plains
LARGE ISLAND
Great Paddy Lands
ROUGH Sketch of HANZAI BASIN
Sea Beach
Sea Beach

3*rd*. With the present scanty population distributed between the towns of Yé and Tavoy, it is not probable that much ore will be collected within that space for some time to come, even were a small depôt formed on the spot for the encouragement of its collection, but in the event of a settlement being formed within Henzai Basin, and the attention of the Chinese emigrants from the Straits directed thereto, I am convinced that, through their agency, the rich deposits of Tin which now lie unnoticed will be developed, the system adopted by the Chinese miners being not merely that of washing the "debris" found in the water-courses, but, by sinking shafts in various localities which indicate the ancient water-courses at the base of the stanniferous formations, the Tin beds are found varying from 6 to 12 feet, and as I discovered the presence of both *Gold* and *Copper* in one of these localities, it is more than probable that, through the medium of such a progress of investigation, rich deposits of both those metals will be eventually found.

4th. With regard to the adaptation of Henzai as a locality for the formation of a new settlement, I beg to offer the following remarks in elucidation of its value in this respect:

A.—The site upon which a native town would be commenced is the Island in the centre, or rather at the Northern extremity of the Basin; upon which, at varying distances from the shore, the higher ground occurs: the intervening space is formed by rich alluvial lands more adapted for grain cultivation, and through this lower portion of the Island convenient nullahs occur at moderate distances in its whole circumference, offering the best possible means of carriage to the cultivator from his village to his grain lands.

B.—The same description of lands exists in great area on the Eastern shore of the Basin, the lower parts of which being admirably adapted for the formation of salt levels, the salt water from the open sea coming in direct at a short distance, clear and unmixed with any diluvial matter from the fresh-water streams.

C.—Both on the Island and in the adjacent forest the wood-oil tree abounds to an extent that employs the natives of several of the villages to the South in its collection, and manufacture into torches for the Moulmein and Rangoon markets.

D.—In the same forests, and on the higher portions of the streams, the finest specimens of "Thengan" are to be found, of which every canoe and trading boat on the coast is formed, and as being superior to teak for the particular purpose of house-building, &c., an abundant

supply of material of the best description, and occupation of a profitable nature, are here present within the reach of all.

E.—The great abundance of fish which the Basin contains offers every facility for the establishment of extensive "fish curings," from which not only Moulmein and Rangoon could receive supplies, but the capacity of supply which the locality possesses, would render its shipment to Bengal a profitable undertaking.

F.—At a part of the coast to the South of the entrance, an extensive patch of Attap Palm occurs, from which the covers to the houses are made, and if to this be added the existence of fresh water of the purest kind in natural springs at several points, and the fact of "game" of the deer kind being numerous in the surrounding jungles, the locality may be said to possess more advantages than any of the other ports on the coast. After traversing the Provinces for nearly their whole length, and on several occasions through their breadth, to the Siamese frontier, I can safely aver that the locality at "Henzai" possesses those elements of progressive prosperity in its valuable mineral deposits and natural advantages, otherwise not equalled by any other part in them.

The most material objection, and that an insuperable one, to "Henzai" Bay becoming the resort of square-rigged vessels of any considerable burden is the Bar at some miles distance from the entrance seaward, which appears to extend almost across the whole space, and leaving only a small passage in shore to the northward, through which the native craft enter; the Bar passed, however, the channel is clear throughout, and both in the passage and inside the Basin 9 to 10 fathoms of water form the soundings, affording space for a large fleet of vessels to lie in still water. The natives state that a passage exists near the centre of the Bar, with 3½ to 4 fathoms in it at high water, which I attempted to examine in a small fishing canoe, but was prevented approaching it by the heavy rollers: this point, however, could be ascertained by the "*Proserpine*" without any risk and with little delay to the periodical trip to the Southern ports.

E. O'RILEY.

MOULMEIN,
15*th January*, 1851.

(True Copies,)

A. BOGLE,
Commissioner, Tenasserim Provinces.

REMARKS

ON

PAPERS AND REPORTS

RELATIVE TO THE

DISCOVERY OF TIN AND OTHER ORES

IN

THE TENASSERIM PROVINCES.

BY

T. OLDHAM, ESQ.

SUPERINTENDENT OF THE GEOLOGICAL SURVEY OF INDIA.

THE daily increasing importance and value of the mineral wealth of the earth, and the many new and hitherto unknown applications of these products, render it of essential importance that new sources of those now largely in use, should be made known; and thus a continued supply kept up to meet the demands of extending manufactures and commerce.

In this point of view, the reports of Mr. E. O'Riley are very interesting, as making known, or rather as confirming the knowledge, of the existence in the Tenasserim Provinces of extensive and rich deposits of Tin ore, and of the occurrence of other valuable ores also: and I can fully agree with Major Bogle in thinking, that the importance of ascertaining something more of the mineral resources of the Southern portion of these provinces, and of the numerous islands in the Mergui Archipelago, cannot be questioned.

If such an examination, however, be undertaken with a view to any practical result, it must be by persons fully competent to the task, and who are capable as well as of estimating the probable commercial value and importance of such deposits, as of ascertaining their existence. There is probably nothing which has more materially, or more universally tended to repress justifiable exertions and speculation in mining

operations, than the failure of schemes founded on the too highly coloured statements of persons, who have formed opinions of the mineral wealth of a country or district from the discovery of some rich mineralogical specimens; valuable perhaps for a cabinet or museum, and interesting mineralogically, but affording no just index to the resources of the district, and giving no evidence whatever of the probability, or even possibility, of a profitable return being derived from any expenditure of capital in such district.

Further, the failure of any scheme, however well founded, so inevitably, and for so long a period, discourages from similar attempts, that such a result is carefully to be avoided in the first opening out of a new field; and the slow and gradual development of the resources of a district is very much more likely to be productive of permanently beneficial result, than the forced growth of any local operation.

I have been induced to make these observations, not as wishing to depreciate the value of Mr. O'Riley's Reports, for I can fully agree, that these Reports give evidence of considerable ability and intelligence, and of zealous perseverance in the examination of the country under considerable difficulties. These Reports are further valuable, even as regards those points on which they are only confirmatory of previous knowledge, as indicating the exact locality of some of those rich metalliferous deposits known to extend over a very large area in the Malayan Peninsula, and extending Northwards into the Tenasserim Provinces.

But to enable a fair opinion to be formed of the *value* of such deposits a much greater amount of detail, as regards the extent of area covered by them, the relative amount capable of being obtained from any given quantity of the ores, the facility of access, the presence or absence of water power, or the abundance of fuel, would all be necessary.

Gold.—Taking the matters of Mr. O'Riley's Reports in the order in which he has placed them, I perfectly agree with him in thinking that the amount and distribution of the auriferous deposits, which he visited, along the banks of the Dzin Bah Choung and the Eem Bah streams in the vicinity of Kalein Oung, are not such as to justify any more systematic or extended research.

It is, I think, obvious, that although the amount stated to be obtainable by a man (*viz.* on the average, 1¼ ticul per month, at the value of 28 to 30 Rupees per ticul, or about 35 Rupees per month, per man,) would be more than sufficient to tempt some persons from a much greater distance than the Siamese frontiers to such employment, still

the smallness of the area, and local character of the deposits, would never yield a sufficiently steady and continuous source of profit to sanction the outlay of capital. Taken in conjunction with any system of workings which may be adopted for the procuring of the Stream Tin, with which the Gold is associated, it may possibly be a source of additional profit to direct attention also to the seeking for Gold (a result easily effected by a slight modification of the ordinary mode of treating Tin ores), but singly, even in much larger quantities than it is stated to occur, the Gold would yield too precarious and uncertain a return to be profitably sought after. And, wherever this is the case with the deposits containing Stream Gold, any search after the original vein containing the metal, and from which it had been washed, would be more than useless.

Nor can I agree with Mr. O'Riley in supposing that the unusually large size of the grain of Gold would lead to the opinion that there must be a "line or vein of auriferous quartz" and rich deposits in its vicinity, inasmuch as the *size* of the grains or materials in any water-carried deposit depends, not on the distance from which they may have been transported, but on the force and transporting power of the water or stream which moved them. The angular and slightly-worn condition of the crystals of Tin-stone in one of the specimens forwarded by Mr. O'Riley, does justify him in supposing that a Tin lode must exist in the vicinity, but the same kind of evidence does not apply to the specimen of Gold, which, in all probability, never was in a true crystaline form, and the rounded condition of which gives therefore no evidence as to the distance from which it has been transported.

Copper.—Among the specimens of Copper forwarded by Mr. O'Riley, there are two small fragments of metallic Copper. One of these appears to me to have been undoubtedly manufactured, and to be a small fragment of some copper vessel, the other is too small to form any opinion regarding it. There are also specimens from some heaps of scoria which Mr. O'Riley traced in three places during his journey, (one of them only a day's march from Moulmein at the Talain village of Kyiek Myraw, and in two other localities between Tavoy and Mergui,) which are peculiarly interesting, as affording valuable evidence of the former workings of the inhabitants of these provinces. As Mr. O'Riley does not notice the occurrence of any remains of villages, or of the habitations of the people who wrought these deposits, it is more than probable that the occurrence of such scoria heaps, at certain localities, points to

the occurrence also in their immediate vicinity of the sources from whence the ores operated on were derived, and these heaps, therefore, may form an excellent guide in any future search for such metalliferous deposits.

I would, however, remark that the extent of such views must be not estimated as *in proportion* to the extent or quantity of the scoria. In the earlier stages of civilization, the processes adopted for smelting and working metallic ores are so rude and so rudely carried on, that the refuse remaining after the completion of the process is generally much more than the useful material obtained, and at the same time while such heaps undoubtedly prove the existence of Copper ores in the neighbourhood, it must be borne in mind, that the demands which such manufactures, as they indicate, were intended to supply were only the very limited ones of a very limited and scattered population, whose wants were few. It must not, therefore, be too sanguinely or too hastily concluded, that the same metalliferous sources would be sufficient to repay any such outlay as would lead to their more extended working.

There appears to me, however, no question that Mr. O'Riley's statements are more than sufficient to justify a careful examination of the localities indicated, with a view to trace, if possible, the sources from which such ores have been derived, although the view which Mr. O'Riley did see, near the entrance of the Toung Byouk river, did not look very promising, nor is the occurrence of "lime-stone" in the vicinity of Moulmein, a very favourable circumstance either.

Tin.—But of all the metallic minerals noticed by Mr. O'Riley, by far the most important, and also apparently the most abundant, is the *Tin-stone*, of which he has forwarded excellent specimens.

The valuable reports of Captain Tremenheere, on the Tin-stones of the Mergui Province, in 1841, and the still earlier reports of Dr. Helfer, in 1837 and 1839, had abundantly proved the existence, over a very large portion of the Tenasserim Provinces, of deposits of Stream Tin, which had been worked extensively under the Burman rule, and from which much ore had been obtained; and to these Mr. O'Riley, has now added the knowledge of some other localities (in which no doubt the existence of Tin might have been inferred from the position, and circumstances of the locality) but where it was not positively known to exist. It is to be regretted that Mr. O'Riley has not forwarded with the specimens he sent, some of the sand and clay in which the Tin-stone occurs in its natural state, unwashed at all, from which an estimate

could be formed of the relative abundance of the Tin-stone and the probable expense of the various operations of washing, &c., to which it would have to be subjected, nor has he stated whether he made any investigation of this point on the ground. To form, however, any estimate of the probability of profitable working of such deposits, it is absolutely essential that we should know not only the per centage of the whole, which the Tin-stone constitutes, but also the average composition of the gravel or sand itself, with special reference to the presence or absence of any materials of equal or greater densities than the Tin-stone, as this most materially affects the facility with which the operation of cleaning the ore for the furnace can be performed. For instance, in one of the specimens forwarded, there is a small quantity of Wolframe sand, which in any appreciable amount would render the working of the Tin unprofitable, from the difficulty of separating it during the washings. Mr. O'Riley has certainly stated as the result of his inquiries, that 6 to 8 lbs. of clean ore can be obtained by a woman during a broken day's work; and estimates that under a regulated system of work by competent men, from 18 to 20 lbs. of ore might reasonably be expected. Should this estimate be correct, there is no question, that such workings would yield large profits in return for the outlay required. But on referring to Captain Tremenheere's reports, I find that his results would not warrant us in supposing more than an average return of 8 to 10 lbs. of clean ore from two men, or only 4 to 5 lbs. from each man during a day's work; a result very different indeed from Mr. O'Riley's.

I have analyzed several portions of the ores forwarded by Mr. O'Riley, and find that, properly cleaned, they will yield from 55 to 65 per cent of pure metal, a fair return.

It would be very desirable, that should Mr. O'Riley undertake any further investigation of these stanniferous deposits, he should direct attention to determining, by actual experiment, the per centage of Tin-stone in the sand, say, the average quantity in a cubic yard: and that in forwarding any further specimen, he should be requested to send some of the sand and gravel or clay, containing the Tin-stone in its unwashed state and just as taken from the ground. The careful examination of the sands containing Tin and Gold has been of great scientific interest during late years, and it would be desirable to be furnished with the means of extending these inquiries to the stanniferous and auriferous sand of the Malayan Peninsula. The constant presence of some mine-

rals in these sands, from whatever country they may have been procured, is a point of interest, tending to elucidate the history of their formation, and though not directly bearing on any practical results, is of sufficient value to justify their examination. In the specimens forwarded by Mr. O'Riley, (which, however, having been previously washed, I did not consider worthy of any very detailed examination,) I have detected the presence of Spinelle, not hitherto noticed in auriferous sands; and also of an extremely minute portion of the rare and valuable metal Platinum, which possibly may occur in larger quantities in other portions of Tenasserim.

Viewing the question of the possibility of developing the mineral resources of these Provinces on a large scale, and the desirableness of the present times for such an attempt, I would venture to direct the attention of His Honor to the recent legislative enactments of the Government of Holland, by which the workings of Tin, hitherto a Government monopoly, have been thrown open to individual enterprise.

These enactments, calculated to instil new energy into such mining operations, have already led to the opening out of the mineral deposits of the valuable Island of Billetin, near Banka, with every prospect of profitable return; and many are now to my certain knowledge looking forward to speculation in this region, as likely to be very productive and remunerating. How far it may be possible to divert some of the already trained experience and skill of English miners, to similar operations within the British territory in the same seas, is a question not now to be decided; but I would impress the fact, that however undaunted the energy, and undoubted the skill of British miners, there is no class of men less likely to undertake such works in districts deprived of regular and constant communication with the towns around and with their own country; and I would suggest that for the fair development of the resources of the Tenasserim Provinces, nothing is so perfectly essential as the opening of roads, and means of communication between the several towns. A district such as Mr. O'Riley has with such energy and perseverance traversed, accessible only through jungle, or up the beds of mountain torrents, is not the country in which any amount of mining energy is likely to develop itself, and although it may be unquestionably true that such means of communication would result from any extension of the trade, or increase of the population of the districts, it is, I think, equally true, that, to a considerable extent, facilities must pre-exist before any progress can be made.

Nay, further, the opening out of such highways of intercourse would in itself form an admirable means of examining the country. The want of population is referred to both by Major Bogle and by Mr. O'Riley, and undoubtedly the opening of a country stated by all who have visited it to be both fertile and healthy, would tend to increase the number of its inhabitants.

There would, however, be no want of population did the means of profitable occupation exist; settlers would be found abundantly to flock to any locality where they would be able to acquire a livelihood on more favorable conditions than at present; and judging from the facility with which Chinese and others are obtained for the workings at Banka, I cannot anticipate any difficulty on this score.

Coal.—The specimens of Coal forwarded with Mr. O'Riley's Reports and alluded to in his "Memorandum on Mineral Specimens" consist of some from the Little Tenasserim, supplied to him by Captain Berdmore, and others from the Lenya river.

Those from the Little Tenasserim river did not prove on analysis equal in quality to the Coal from the same vicinity referred to in the Reports of the Coal Committee (1846, pages 144-145,) a difference accounted for by Mr. O'Riley from the fact of his specimens having been taken from the surface after having been exposed to atmospheric influence.

His Reports do not afford any information regarding the facility of access to this Coal, or the possibility of its economical extraction.

The specimen forwarded can scarcely be called a Coal at all, consisting almost entirely of Argillaceous shale, charged with a considerable amount of bituminous matter, and consequently inflammable; some few thin flakes of pure Coal occur traversing the mass.

With regard to the specimens from the Lenya river, called by Mr. O'Riley Cannel Coal, they are peculiarly interesting, geologically, from the abundance of amber or resinous matter which they contain, in thin flakes, and small nodular masses. Although from all analogy the presence of this amber would lead me to suppose that this "Coal" is geologically of much more recent date than the true carboniferous system, I should be unwilling to arrive at any definite conclusion from such small hand specimens.

It is the presence of this amber, which renders the mass so highly flaming, and which might possibly render it a useful material for the manufacture of gas, but it entirely unfits it for sea-going steamers, or any purposes, where it would not be stationary.

In several of the reports submitted to me, and also in the published reports of persons employed by Government to examine various districts, I find such variety of statements with reference to Coal, and such uncertainty as to the relative values of the different kinds submitted to trial (most of these reporters appearing to suppose that the power of *raising steam rapidly* is all that is necessary), that I would beg to submit for the information of His Honor the Deputy Governor of Bengal a brief summary of the qualities which every Coal should possess for the purposes of sea-going steamers. That the fuel used should be capable of raising steam in a short time, or, in other words, that it should be *quick in its action*, is desirable, but it must also possess high evaporative power, or be *capable of converting a large quantity of water into steam*, relatively to the consumption of fuel; it must besides have such a *cohesion among its particles*, as that the constant motion of the vessel should not break it into small fragments, and further it must unite with a considerable density, such a *mechanical structure as will enable it to be stowed in small space:* a difference of great importance, inasmuch as in Coals possessing the same evaporative power, or capable of converting the same quantity of water into steam, there is frequently a difference in respect of stowage of fully 20 per cent; that is, 120 tons of one Coal can be stowed in the same space as only 100 tons of the other. There are points not peculiarly applicable to Coals used for steamers, but to be attended to in all Coals, such as the absence of any considerable quantity of sulphur, which would render it liable to spontaneous combustion; and the absence also of any undue amount of bituminous matter, which would produce a disagreeably large amount of smoke.

Undoubtedly all these qualities do not exist together in any one Coal, but the value of a fuel, specially for the purposes of steam ships, essentially depends on the comparative presence or absence of a combination of these qualities.

Viewed, therefore, with reference to these qualities, neither of the Coals submitted by Mr. O'Riley, (even supposing they could be obtained in any quantity and economically) are calculated to prove a good fuel for sea-going steamers; they both possess too little cohesion of particles, or are too brittle. The evaporative power of one is very low, that of the other rather high, but too rapid; while neither promise to *stow* well. These opinions must, however, be understood as formed solely from an examination of the specimens sent forward by Mr. O'Riley, and which may not afford a fair average of the Coals procurable in the District.

The papers subsequently received also are to my mind quite conclusive as to the improbability of any profitable workings being carried out to any extent in the localities Mr. O'Riley has described; as well from the difficulties of access, and want of facility of carriage, as from the unpromising nature of the beds which he has described.

Major Bogle has very justly directed attention to the fact of an extension of Steam Communication in the Eastern seas, as a strong inducement to ascertain precisely the probability of useful deposits of Coal being formed in such localities within the Tenasserim Provinces, as might be readily accessible. There can be no question that the discovery of any extensive and easily wrought coal field in these Districts, would be one of extreme importance. The rapidly increasing spread of Steam Communication to India, to the Cape of Good Hope, and onwards to China, and the contemplated establishment of lines of Steam Communication between the Australian Colonies and other places, both by Panama and the Cape, together with the shorter lines, which must inevitably be dependent on these great undertakings; all these indicate the value of any good Coal field conveniently placed for the supply of fuel to the many depôts, which must be established; and in many respects the Tenasserim Provinces possess great advantages, as regards the locality, and the question of the existence of good and extensive deposits of mineral fuel in these Provinces, becomes, therefore, one of very much larger scope and importance, than if viewed simply as regarded to Coal supplies.

I am not inclined to rely much on the statements made to Major Bogle that the Coal Mining operations in Mergui were discontinued just at the time "when very superior Coal had been discovered, and they "promised very favourably." Such assertions are almost invariably made on the abandonment of any mine, and generally proceed from persons who allow their private interests to overcome their accuracy of statement; and Major Bogle is also perfectly justified in repudiating the objection (of its spontaneous combustion) urged against some of the Mergui Coal, as being applicable to all; the cases in which this occurred may have originated in carelessness in shipping the Coal, or in many other ways, on which, without a knowledge of all the circumstances, I could not speak; but even did the combustion arise from the peculiar chemical composition of the Coal, the serious objection arising from it, would only apply to Coal of the same quality and from the same bed;

and by no means to other Coal, which might perhaps be obtained within a few feet of the bad fuel, and yet possess all the qualities of a good useful coal. Major Bogle's letter alludes to mining operations carried on by Government in the Mergui District. Of the extent and character of these operations, I have no knowledge whatever, but I am disposed to think that no mining operations whatever should be undertaken or carried on immediately by the Government of this country. To conduct satisfactorily any mining operations, demands, on the part of those superintending them, such an amount of constant and unremitting attention, as can scarcely be expected where the personal interests of the parties are not concerned, and where the responsibility is to a great extent divided, and the experience of all past attempts fully confirms the opinion, that it is much more expedient that private parties should be induced (even by allowing them at first great benefits and large profits) to undertake such schemes, than that Government should through their agents do so.

I respectfully conceive that all that a Government is fairly called on to do is to obtain such information as may be depended on for its accuracy, and shall be entirely above the suspicion of being given by interested parties. And this information, when considered desirable, being made public, there can, I should think, be little question, that if a fair prospect of good remuneration exist, there will be no want of persons to undertake the practical and actual working of the scheme, and one advantage resulting from this is that the persons whose attention is likely to be attracted by the publishing of such information, are exactly those who, from former experience or previously acquired skill in similar undertakings, are the most likely to be successful in carrying them on. Restrictions as to the mode of working will undoubtedly be desirable to guard against a waste of the valuable material, and the chances of loss of human life; and should mining operations become considerably extended in India, certain legislative enactments regulating the operations, may be necessary; but at the first opening of a District such will not be required.

From these considerations, I would most fully coincide with Major Bogle in recommending that mining operations should not be renewed on the part of the Government, either at present, or at any future period, while I equally agree in thinking it both important and expedient, that the Provinces to which he refers, should be carefully examined and reported on.

Lead.—Among the specimens forwarded by Mr. O'Riley, are some small ores of Galena (sulphuret of lead) of good average quality, one specimen I subjected to a trial, and found it to contain about 175 ounces of Silver to the ton. But the amount forwarded was not sufficient for a fair analysis, and in the absence of any information as to the circumstances of the locality, and the quantity of ore obtainable, I do not anticipate any very favorable results from such ore.

Iron.—I would fully confirm Mr. O'Riley's report that the extraction of such ores of Iron as those forwarded, under the circumstances of difficulty he enumerates, would afford no encouragement as a profitable operation.

Henzai Bay.—The desirability of ascertaining the existence of a good and easily accessible harbour, so favourably placed on a coast, which in many respects is unfavourable to navigation, must be obvious; and the statements of Mr. O'Riley referring to Henzai Bay, will, I doubt not, receive the attention they merit from the Marine Authorities, but its advantage can only be ascertained by careful examination by some competent person. The existence of a Bar under the circumstances of the locality would seem unavoidable, but it may be possible, if considered desirable, to improve the entrance to the Bay very considerably, by a trifling expenditure. Mr. O'Riley's statements appear to me sufficient to call for an examination and report on the Bay by some competent Naval Officer.

In briefly reviewing the whole of the papers submitted to my examination, I would beg to offer my testimony to the zeal and energy which Mr. O'Riley appears to have shown in the prosecution of the task entrusted to him.

The great extent of the stanniferous deposits, and their reputed richness, amply justify a more accurate and detailed examination, with a special view to determine, as far as may be practicable, their commercial value, and their probable extent, disregarding as of minor importance, the ascertaining of any new localities, where Tin-stone may occur.

The present indications of Copper do not appear to me to be, in themselves, sufficient to warrant any detailed examination of the district for Copper; but of course, this would form one point of inquiry, should any Geological investigation of the country be undertaken.

To establish the existence of an extensive and accessible field of good Coal, is essentially important, and the numerous and favorable,

although in many respects conflicting statements, regarding the Coal of the Tenasserim Provinces, call for further and more competent investigation, before any decided practical result can be anticipated.

THOMAS OLDHAM,
Superintendent of the Geological Survey of India.

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